MACHINE PROGRAMMING THE BALLY ARCADE
(Bare bones-Basic only)

The z-80 operates on poked in data,16 bits at atime, the two bytes in reverse order. For instance if you had poked in the opcodes 0F D3 , the processor reads it as D3 0F. Since Bally Basic does not understand hex code, the opcodes must first be converted to decimal notation. Say you wanted to poke in D5 00- First the bytes are swapped(00 D5),Then the decimal value of each hex digit is multiplied by its column position and the results added together. i.e. 0x4096 + 0x256 + D(13)x16 + 5x1 = 213 =(00 D5)=(processor reads as)→D5 00. If the decimal value you obtain is over 32767, subtract 65536 and sign negative. example;

Hex values	Bytes to be converted	swap	multiply	add together
0	7A	D3 7A	Dx4096 =	53248
1	D3	00 0F	3x256 =	768
2	0F		7x16 =	112
3			Ax1 =	10
4			over 32767 so	54138
5			subtract	65536
6				
7				
8				
9				
A(10)				
B(11)				
C(12)				
D(13)				
E(14)				
F(15)				

first 2 byte value to poke → -11398
Second 2 byte value is → 15

Memory that may be used for running machine programs is; Line buffer 20180-20283 (104 bytes,4ED4-4F3B) Variables thru CY (20078-20138-A→Z,BC, FC,NT,CX,& CY=61 bytes) And tape input buffer 20002-20049(4E22→4E51=48bytes).A complete listing of memory mapping is on pg.34 vol.1.Essential machine programming info. for the custom chips(ports-interrupts-control bits-etc.)may be found in the PA-2 service manual.To set ports simply convert the"&" value to hex.Use the Z-80 inst. LD,A(3E,<B2>)(to load accumulator to value you want to set port to)Then output it to I.O. w/ the inst. OUT(<B2>),A(where <B2> is the second byte of a two byte op-code)The op-code of this inst. is D3,<B2>.The hex code used in the second byte will be your port #.example; SEt &(21) to 205 $\overset{1}{\rightarrow}$LD,A<B2>" 3E CD " (CD=205)$\overset{2}{\rightarrow}$OUT(<B2>),A " D3 15 " (15=&(21)).swap 2 bytes at a time,convert to dec. poke in ,and CALL. To make a "GOTO",use JP<B3>,<B2> which is C3<B3>,<B2>.B3&B2 are the "GOTO" address in hex,put in the actual inst. in reverse order.These may be Reversed again when you swap before converting.Say you want to jump back to the beginning of the line buffer.Use-C3-D4-4E-.Of course you cant jump back to a Basic prog. this way.To set up a machine prog. which will be called in a basic prog. & then get back to the basic prog.,the first byte in your mach. prog. should be D5(PUSH DE) -(To save basic pointer). To get back to basic,at end of machine segment-D1-C9(POP DE-RET). You can't use the screen area(16384-19998) for mach. prog. if your graphics or printing overlaps area you are using.A scroll will also destroy your program here. So get out your calculator & Z-80 manual and start experimenting! Good luck- (an example breakdown of rainbow display#1 follows) ;NOTE AF-BC-HL must also be pushed and popped for some interrupt operations.

1
X = 16354
89 = 20
For x = X to 199966 step 20

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Hex values|  Bytes to be converted| swap | multiply | add together
0                    7A                 D3 7A   Dx4096  =   53248
1                    D3                 00 0F   3x256   =     768
2                    0F                         7x16    =     112
3      |Memory that may be used for|  .         Ax1     =      10
4      |running machine programs is;|     over 32767 so    54138
5      |Line buffer 20180-20283             subtract       65536
6      |(104 bytes,4ED4-4F3B)   |first 2 byte value ---> -11398
7      |Variables thru CV       |       to poke
8      |(20078-20138-A→Z,BC,    | Second 2 byte value is → 15
9      |FC,NT,CX,& CY=61 bytes) |
A(10)  |And tape input buffer 20002-20049(4E22→4E51=48bytes).A complete
B(11)  |listing of memory mapping is on pg.34 vol.1.Essential machine
C(12)  |programming info. for the custom chips(ports-interrupts-
D(13)  |control bits-etc.)may be found in the PA-2 service manual.To
E(14)  |set ports simply convert the"&" value to hex.Use the Z-80 inst.
F(15)  |LD,A(3E,<B2>)(to load accumulator to value you want to set port
        to)Then output it to I.O. w/ the inst. OUT(<B2>),A(where <B2> is
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the second byte of a two byte op-code)The op-code of this inst. is D3,<B2>.The hex code used in the second byte will be your port #.example; SEt &(21) to 205 $\xrightarrow{1}$LD,A<B2>" 3E CD " (CD=205)$\xrightarrow{2}$OUT(<B2>),A " D3 15 " (15=&(21)).swap 2 bytes at a time,convert to dec. poke in ,and CALL. To make a "GOTO",use JP<B3>,<B2> which is C3<B3>,<B2>.B3&B2 are the "GOTO" address in hex,put in the actual inst. in reverse order.These may be Reversed again when you swap before converting.Say you want to jump back to the beginning of the line buffer.Use-C3-D4-4E-.Of course you cant jump back to a Basic prog. this way.To set up a machine prog. which will be called in a basic prog. & then get back to the basic prog.,the first byte in your mach. prog. should be D5(PUSH DE)-(To save basic pointer). To get back to basic,at end of machine segment-D1-C9(POP DE-RET). You can't use the screen area(16384-19998) for mach. prog. if your graphics or printing overlaps area you are using.A scroll will also destroy your program here. So get out your calculator & Z-80 manual and start experimenting! Good luck- (an example breakdown of rainbow display#1 follows) ;NOTE AF-BC-HL must also be pushed and popped for some interrupt operations.